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Acanthohaustorius uncinus, a New Species of Sand-Burrowing Amphipod from the Northern Gulf of Mexico, with Notes on its Ecology (Haustoriidae: Haustoriinae)

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ACANTHOHAUSTORIUS UNCINUS, A NEW SPECIES OF SAND-BURROWING AMPHIPOD FROM THE NORTHERN GULF OF MEXICO, WITH NOTES ON ITS ECOLOGY (HAUSTORIIDAE: HAUSTORIINAE)

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ABSTRACT A new species of sand-burrowing amphipod, *Acanthohaustorius uncinus*, is described from vegetated and unvegetated estuarine sands from St. Andrew Bay, Florida and East Ship Island, Mississippi. The genus *Acanthohaustorius* has been informally recorded from St. Andrew Bay, but this species is now formally described from the Gulf of Mexico. *A. uncinus* n. sp. is most similar to *A. millsi* of the open American Atlantic coast. It differs from *A. millsi* in the presence of a dorsally directed, hooked spine on the peduncle of uropod 1 and the totally cleft telson lobes. Information on the ecology of *A. uncinus* n. sp. in St. Andrew Bay is provided, along with a revised key to the known species of *Acanthohaustorius* and a brief review of haustoriid studies in the Gulf of Mexico.

Introduction

The sand-burrowing amphipods of the family Haustoriidae Stebbing, 1906 comprise one of the dominant macroinfaunal components of the sandy inlets and beaches of the Gulf of Mexico and the Atlantic coasts of the United States and Canada (Bousfield 1970). The subfamily Haustoriinae Bousfield, 1965 comprises six genera of amphipods variously adapted to high energy environments in marine and estuarine sediments. The distribution of the subfamily and the ecology of several species have been treated by Croker (1967), Dexter (1967), Sameoto (1969), Bousfield (1965, 1970), Shelton and Robertson (1981), and Thomas and Barnard (1984).

In contrast to the Atlantic coast, studies have been limited of haustoriid amphipods in the Gulf of Mexico. Initially, Pearse (1908) described *Haustorius americanus* from Louisiana. Bousfield (1965) reexamined Pearse's material and placed the amphipod in the newly created genus *Pseudohaustorius* and separated it from *P. carolinensis* Bousfield, 1965 by its lack of a terminal segment on the outer ramus of uropod 3. Pearse (1912) also reported *Haustorius arenarius* Slabber from the *Albatross* expeditions of 1885 off Pensacola, Florida. Croker (1967) considered early records of *H. arenarius* erroneous identifications. Until Pearse's material is reexamined, this record from the Gulf remains dubious. No new Gulf species were documented until *Protohaustorius bousfieldi* and *Parahaustorius obliquus* from Texas beaches were described by Robertson and Shelton (1978). The study of beach fauna which revealed the new species also produced undescribed species of *Lepidactylus* and *Acanthohaustorius* (Shelton and Robertson 1981). The complex problem of *Lepidactylus* in the Gulf of Mexico has been partially related to the unclear distinction between it and *Haustorius*. Robertson and Shelton (1980) clarified some of these relationships and described a new species, *Lepidactylus triarticulatus*, from intertidal, fine-grained sand beaches from Padre Island, Texas to Grand Isle, Louisiana. *L. triarticulatus* was compared to a second undescribed species of *Lepidactylus* known from Little Deer Island, Mississippi that possibly ranges into western Florida (E.L. Bousfield, per. comm.).

The exact number of undescribed haustoriids from the Gulf of Mexico is unclear. A comprehensive examination of material recovered in ecological surveys around the Gulf is needed in order to assess the representation of the family, specifically the subfamily Haustoriinae.

The genus *Acanthohaustorius* has not been formally treated from the Gulf of Mexico. This genus is endemic to North America, as are all the representatives of Haustoriinae, except *Haustorius*, and contains seven species from the Atlantic coast from Canada to the Florida Keys: *A. spinosus* (Bousfield 1962); *A. millsi* Bousfield, 1965; *A. intermedius* Bousfield, 1965; *A. shoemakeri* Bousfield, 1965; *A. bousfieldi* and *A. similis* Frame, 1980; and *A. pansus* Thomas and Barnard, 1984. Among these species, reported habitats range from fine sediments in sheltered inshore waters to coarse sand and shell bottoms in offshore waters at

depths as great as 40 meters (Dexter 1967, Frame 1980, Thomas and Barnard 1984).

Recent ecological and environmental monitoring studies in St. Andrew Bay, Florida, a high salinity estuary on the northern coast of the Gulf of Mexico, have revealed the presence of several undescribed species of *Acanthohaustorius*. Saloman (1976) reported an unknown species of *Acanthohaustorius* from almost pure quartz sand in waters of 3 to 10 meters in a study of the sediments and fauna of the surf zone and nearshore vicinity along the Gulf beaches outside St. Andrew Bay. Saloman et al. (1982) found a different *Acanthohaustorius* sp. to be the most widespread haustoriid within St. Andrew Bay. This study, directed toward benthic faunal assemblages from vegetated and unvegetated habitats, revealed the presence of the unknown species in 31 of the 89 unvegetated sand stations and from 7 of the 60 stations vegetated with a mixture of *Halodule* and *Thalassia* which were examined along the shallow, subtidal bayshore. Sediments varied from fine to medium sand. Taylor (1987) reported two unknown species of *Acanthohaustorius* from similar habitats to a depth of 4.6 meters. The numerically dominant form, referred to as *Acanthohaustorius* sp. A. by Taylor (1987), is presumably the *Acanthohaustorius* sp. of Saloman et al. (1982) and has affinities with *A. millsi*. The less numerous form, *Acanthohaustorius* sp. B., of Taylor (1987) is similar to *A. intermedius* (Richard Heard, per. comm.). Materials examined from East Ship Island, Mississippi conform to sp. A. of Taylor (1987) in morphology and habitat.

Materials and Methods

Sediment samples were obtained with a hand-held coring device of 1/64 sq. meter which penetrated the sediment to a depth of 23 cm. Sediment samples were washed in the field through a 0.5 mm mesh screen and the retained material was fixed in 10% formalin. In the laboratory, samples were washed in tap water through a 0.5 mm mesh screen. Amphipods were removed from the retained materials and preserved in 70% isopropyl alcohol. Materials examined from Taylor (1987) were collected and fixed in the same manner, except that they were stained with Rose Bengal. Dissections were performed under a Wild M-5 stereoscope. Body parts of the paratypes were mounted in anhydrous glycerine on Cobb slides. Examinations and drawings were made with a Nikon Differential Interference Contrast microscope with a drawing tube. Hydrological and sediment analysis from the type locality are available in Saloman et al. (1982) and Taylor (1987).

Results

Haustoriidae Stebbing, 1906
Haustoriinae Bousfield, 1965
Acanthohaustorius uncinus new sp.
Plates I-III

Materials examined

Holotype – Female "f", National Museum of Natural History, USNM 235055, 5.0 mm; St. Andrew Bay, Florida, 30°19'25" N, 85°42'52" W, unvegetated fine to medium sand and shell, depth 2.0 meters, J.L. Taylor, collector.

Paratypes – 1 female "a", 4.7 mm, USNM 235185; 1 male "b", 4.5 mm, USNM 235186, St. Andrew Bay, Florida, 30°19'50" N, 85°41'50" W, fine sand, 21 January 1984. 1 male ***allotype*** "c", 4.0 mm, USNM 235187, St. Andrew Bay, Florida, 30°17'15" N, 85°41'19" W, subtidal fine to medium sand, 21 November 1987, J.M. Foster, collector. 3 females "d", 5.0 mm, USNM 235188; "e" 5.0 mm, USNM 235189; 3 males "g", 4.5 mm, USNM 235190; "h", 4.5 mm, USNM 235191; "i" 4.3 mm, USNM 235192; St. Andrew Bay, Florida, 30°19'25" N, 85°42'52" W, unvegetated fine to medium sand and shell, depth 2.0 meters, J.L. Taylor, collector. 1 male "j" 5.0 mm, USNM 235193; 1 female "k" 5.0 mm, USNM 235194; 1 juvenile "m" 2.0 mm, USNM 235196; St. Andrew Bay, Florida, 30°04'17" N, 85°38'48" W, fine to medium sand with quartzite gravel, depth 0.5 meters, 3 January 1987, J.M. Foster, collector. 1 male "l" 4.5 mm, USNM 235195, East Ship Island, Mississippi, dredge in medium sand, depth 3.0 to 4.0 meters, 23 June 1987, R.W. Heard, collector.

Diagnosis

Maxilla 1, inner plate with 6 sparsely plumose setae, outer 3 minutely pectinate; article 5, pereopod 6 with horizontal ventral margin armed with 6 spines, posterior margin with 3 spines; article 6 posterior margin with 3 spine groups; coxa 7 acute posteriorly; uropod 1 peduncle with 3-5 dorsolateral spines, naked ventrally, 1 interramal spine and 1 large dorsally directed, hooked spine distally, inner ramus subequal to outer; telson lobes with slight concavity distolaterally, each lobe with 1 plumose seta; lobes completely cleft, appearing to be separate.

Description

Paratype – Female "a" 4.7 mm. Body broad, barrel-shaped. Head broader than long; rostrum blunt, sub-

conical, wide at base. Eyes translucent white in life, not apparent in preserved material.

Antenna 1 – Article 1 longer than deep; oblique row of 3 plumose setae from midline of article 1 to anteroventral margin, lateral margin with 7 pilose spines; article 2, 0.73 times width of article 1, article 2, 1.1 times length of article 1; flagellum 5 segmented; accessory flagellum with 2 subequal segments.

Antenna 2 – Article 3 with 2 short, simple setae and 1 long plume posteriorly; article 4 long, with broad posterior lobe, posterolateral margin with 9 elongate, finely pilose spines, posterior margin with numerous elongate plumose setae, sparse simple and pilose spines on dorsal and lateral margins; article 5 expanded distally with 1 distomedial pilose spine; flagellum 5 segmented, article 1 longest, setae inserted distally in articles.

Lower lip – Inner lobes broadest distally, outer lobes round, both pilose marginally; outer lobes with 5 short, stout spines on inner medial surface near distal margin.

Upper lip – Broad, apex bare.

Mandible – Incisor bifid, lacinia mobilis short, broad at base, raker row of 5 terminally serrate, spatulate blades, molar triturative, palp article 2 with 4 simple setae; palp article 3 with 12 spines in comb row; apical spines 11, distally narrowed and minutely pectinate; left mandible without lacinia mobilis, 5 blades in raker row and 1 short spine lateral to raker row.

Maxilla 1 – Inner plate with 3 medial, sparsely plumose setae and 3 medial, minutely pectinate spines; outer plate with 13 apical spines, 3 of which are blunt, translucent blades; palp 2 segmented with marginal and apical plumose setae; inner and outer plates finely pilose.

Maxilla 2 – Inner plate slender, with medial row of marginal plumose setae, aboral surface with facial row of plumose setae; outer plate expanded distally, forming an oblique lateral lobe, lateral margins finely pilose, inner medial margin bearing long, wisely-spaced plumose setae, aboral lateral margin with 13 pectinate spines.

Maxilliped – Inner plate with medial, simple setae along inner margin, apical margin with 2 blunt spines, 6 long, acute spines, and 2 short, penicillate setae; outer plate broader than inner; subacute inner margin with 11 blunt spines, subacute lateral margin with several rows of simple setae; palp article 2 produced distally to near transverse outer margin of article 3, several rows of long setae on inner distal margin and two strong distal setae on outer lateral margin; palp article 3 geniculate, with elongate, simple setae marginally and with pectinate terminal setae.

Coxae 1–4 – Ventral margins forming a gentle, dorsally directed curve posteriorly; coxae contiguous, progressively longer and broader posteriorly.

Gnathopod 1 – Coxa deeper than wide, slightly excavate posteriorly, 3 plumose setae on posterior margin, 3 elongate plumose setae and 1 short simple seta on posteroventral margin, 3 simple setae on anterodistal margin; article 2 elongate with 6 posterior marginal setae; article 5 expanded posteriorly with dense clusters of setae on posterior margin; article 6, anterodistal margin with 4 dense clusters of setae each with recurved tips and a single accessory setule; dactyl with strongly projecting nail.

Gnathopod 2 – Chelate; coxa similar in shape to coxa 1, but slightly longer; posterior margin with 5 plumose setae, posterovental margin with 3 plumes and 1 short, simple seta; article 2 elongate, posterior margin with 7 evenly spaced, very long, simple setae, posterodistal margin with a cluster of 7 long, simple setae; article 5, ventral margin with about 12 marginal setae and 4 groups of 5-5-3-1 spatulate, marginally pectinate spines on the distal half of the posterior margin; article 6 elongate, posteroventral margin with 5 long, distally tapered, toothed spines; anterodistal margin with 5 transverse rows of long, club-tipped setae and elongate, finely toothed spines.

Pereopod 3 – Coxa scythe-shaped, posterior margin with 8 plumose setae, posteroventral margin with 1 very long, glassy spine, 1 setule on anterodistal margin; article 2 elongate, posterior margin with 3 plumed setae distally; article 4, anterior margin with 7 plumed setae, posterior margin densely setose, 5 long plumes on posterodistal margin; article 5, clusters of 4 setae at anterodistal margin, 11 spines, some with accessory setules, and 3 plumes arranged around a posteriorly directed circular cusp; article 6 with 10 spines, some with accessory setules, and 5 plumes arranged around an ovate cusp.

Pereopod 4 – Coxa broad, posterior margin slightly excavate, 2 ventral setae; article 2 elongate, 2 setae and 1 plume on posterodistal margin; article 4, 7 plumes on anterior margin, anterodistal margin with slender seta and 2 curved, pectinate spines, posterior margin with 4 spines and 4 plumose setae, posterodistal margin with an oblique row of 4 plumed setae inserted lateral to margin; article 5 expanded distally, 1 slender spine and 2 recurved pectinate spines anterodistally, 7 spines and 4 plumes arranged around a posteriorly directed cusp, some with accessory setules; article 6 with 10 spines and 3 plumes surrounding a shallow, ovate cusp, 1 slender penicillate seta terminally.

Pereopod 5 – Coxa much broader than deep, bilobed ventrally; 2 setae on posterior margin; article 2 slightly expanded posteriorly, posterior margin with 6 setae;

anterior margin with 14 plumed setae and 2 slender spines; article 4 width-depth subequal, posterior margin expanded, 6 anterior marginal spines, each with an adjacent plumed seta, anterodistal margin with 1 long and 2 short spines, 2 groups of 4 and 3 spines located ventromedially, posterodistal margin with 3 spines, posterior margin spine formula 2-2-3, posterior facial spine formula 3-5; article 5, anterior margin with 2spines and several plumes, ventral margin near anterodistal juncture with 1 short and 3 long spines and several plumed setae, 6 ventral spines near posterior margin, posterior margin with ventrally directed, bilobed expansion, lower lobe with 1 long spine and several plumes, upper lobe with a row of 3 spines lateral to margin and numerous plumose setae, anterior facial spine formula 10-6, posterior facial spines 1 lateral row of 6 spines; article 6, anterior spine formula 3-3-2, apex with 2 short and 3 long spines and 1 penicillate seta.

Pereopod 6 – Coxa small, rounded posteriorly, 2 setae on posterior margin, article 2 quadrate, deeper than wide, posteroproximal margin with 4 setae, anterior margin with dense plumed setae and 2 groups of 2 setules distally; article 4, anterior marginal spine counts 1-1-1-2-2-3-3, anteroventral margin with 3 spines, ventrolateral margin with 2 groups of 2 spines, posteroventral lobe with 3 spines, ventral margin richly plumose, posterior margin with 4 spines and numerous plumose setae, anterior facial spine formula 2-2-2, posterior facial spine formula 3-3; article 5 subquadrate, narrowed slightly at articulation with article 4; ventral margin perpendicular to sides, anterior marginal spine formula 1-2-2-4, anterodistal margin with 6 spines, ventral margin with 6 spines, posterodistal margin with 1 short and 3 long spine groups, anterior facial spine formula 2-1, medial facial spine formula 1-1; article 6, one-fourth as wide as long, posterior margin spine formula 3-2-2, apex with 10 spines and 1 penicillate seta.

Pereopod 7 – Coxa small, posterior lobe acute with 1 short setule at apex and 2 setules on posteroventral margin; article 2 large, orbicular with 15 plumose setae on proximal half of anterior margin, 7 long, distally narrowed, minutely pectinate spines on distal half, anterodistal margin with 1 short and 4 pectinate spines, posterior margin with 2 short, simple spines; article 4 produced posteroventrally, anterior margin with several plumed setae (formula 2-4-4), spine formula 1-2, anterodistal margin with 2 long spines and 1 plume, ventral margin with an anterior and posterior cluster of 3 spines inserted laterally to margins, 9 medial ventral spines, posterodistal margin with 1 long spine and 1 plume, posterior margin with 1 spine and 7 plumes; article 5, anterior marginal spine formula 3-6-7-5-2-5, 1 oblique row of 3 spines proximal to ventral margin anteriorly, ventral margin with 1 cluster of 3 medial and 2 slender setae near posterior margin, posterior margin naked, gently rounded, posterodistal margin with 2 spines, medial facial setal formula 2-2-2-2, posterior facial setal formula 1-1; article 6 anterior spine formula 1-3-4, posterior spine formula 2-4-4, apex with 8 spines and 1 penicillate seta.

Pleosome – Side plates 1 and 2 posterodistally produced. Pleosome side plate 3 with plumed lateral setae in formula 2-5-4-4 and a stout, dorsally directed, ventrodistal spine.

Pleopods – Pleopod 1, rami slender, inner ramus 12 segmented, outer ramus 13 segmented, peduncle with lateral setae, sparsely setose, retinacula 2. Pleopods 2 and 3 generally similar, pleopod 3 smaller and shorter.

Uropod 1 – Peduncle stout, length 4 times depth, outer margin with 3 short dorsolateral spines, ventral margin naked, 1 interramal spine, peduncle with large, dorsally directed hooked spine distolaterally; outer ramus slightly longer than inner, marginal spine formula 2-4, 9 apical spines situated in a terminal circlet, several bifid distally; inner ramus subequal to outer, 2 short spines and 3 singly inserted setae along margin, 7 apical spines with several bifid distally.

Uropod 2 – Rami subequal, both rami with long, terminal setae; peduncle twice as long as wide with an oblique row of simple facial setae.

Uropod 3 – Peduncle much shorter than rami, longer than wide; outer ramus longer than inner, 2 segmented, both articles with terminal setae; inner ramus 85% length of outer with a cluster of 3 medial setae, apical setae in dense cluster.

Telson – Cleft to base with lobes appearing to arise separately from dorsal surface of urosome; outer distal margin of each lobe with slight concavity, lobes with 8-10 marginal setae and 1 stout penicillate seta medially, inserted proximally from the marginal setae.

Gills – Laminar, present on pereopods 2-6.

Brood plates – Setose, plate on pereopod 2 smallest, plates on pereopod 3 and 4 large, subequal.

Allotype – Male, 4.0 mm; Generally similar to female, slight and inconsistent variability in setation and spination between male and female. Mouthparts identical with regard to mandibular blades, mandibular palp segment 2 comb spines, apical spines on outer plate of maxilla 1, spine grouping on inner plate of maxilliped. Slight variation in marginal and facial spination on pereopods 5-7; pereopod 5, article 5, anterior facial spines 9-6, posterior, 5; article 6, anterior marginal spines 2-2-4, 3 long and 2 short terminal spines, pereopod 6, article 5, anterior facial spines 2-2, posterior 1-1-2, anterior marginal spines 1-2-2, posterior 1-1-2-2; article 6, posterior marginal spines 2-4-3; pereopod 7,

article 5, anterior marginal spines 4-4-6-7, article 6, anterior marginal spines 1-2-3-3, posterior 4-4. Uropods similar, but many males have 5 dorsolateral spines on the peduncle of uropod 1.

Remarks

Individual variation in the number and location of spines and setae is common in haustoriid amphipods. Thomas and Barnard (1984) commented on the difficulty of obtaining a set of characters which would withstand the normal range of intraspecific variation. They concluded that the spine morphology of pereopods 5-7 and uropod 1, especially the peduncle, and the configuration of the telson vary only slightly and may be useful in sorting species. These characteristics, and others, were examined on the available specimens of *A. uncinus* n. sp. Some degree of variation was encountered among all the individuals examined, especially in pereopods 5-7; mouthpart armature was fairly consistent among the individuals examined. However, *A. uncinus* n. sp. displays a consistent hooked, distal spine on the peduncle of uropod 1, a single interramal spine on uropod 1, and a near totally cleft telson in both sexes. The numbers of dorsolateral spines on the peduncle of uropod 1 is important in distinguishing some species of *Acanthohaustorius*: *A. millsi* has 3-4 spines while *A. similis* has 8-10 spines. The counts for the examined *A. uncinus* n. sp. varied from 3 to 5, with males generally bearing 5. The marginal spine formulas on the outer ramus of uropod 1 were considered as a character, but varied considerably among individuals and were discounted as useful in separating *A. uncinus* from other species in the genus. Setation on the inner ramus of uropod 1 varied from 3-6 setae and both single and double insertion was observed. Between the sexes, however, there was remarkable similarity in the armature of the mouthparts. Future work may show the value of spination on pereopods 5-7 in distinguishing *A. uncinus* n. sp. from other species, but in my observations, I was not able to separate sexes on those characters.

Ecology

Occurs in fine to medium unvegetated sands with shell fragments and in fine to medium sands with some silt among halophytes *Thalassia testudinum* and *Halodule wrightii* to an observed depth of 4.6 meters.

Distribution

Northern Gulf of Mexico, St. Andrew Bay, Florida to East Ship Island, Mississippi.

Etymology

From the Latin "*uncinus*" meaning "hooked." This is in reference to the distal hooked spine on the peduncle of uropod 1.

Key to the Species of *Acanthohaustorius*

(from Thomas and Barnard (1984) modified for insertion of *A. uncinus* n. sp.)

1. Telson U-cleft less than one-half to base, lobes truncate, posterior margins straight, outer margins with slight concavity; pereopod 6 article 5, distal margin oblique; setae on inner ramus of uropod 2 arranged in clusters. . . . . *A. spinosus*

   Telson cleft to base or nearly so; lobes of telson posteriorly rounded; pereopod 6, distal margin of article 5 horizontal; setae on inner ramus of uropod 2 singly inserted 2

2. Telson of two widely separated and distinct lobes; pereopod 6 article 5 with 4 or fewer single facial spines, article 6 posterior margin with 1–2 clusters of spines . . . . . *A. pansus*

   Telson lobes not widely separated; pereopod 6 article 5 with more than 4 facial spines, posterior margin of article 6 with 3–5 spine clusters 3

3. Coxa 3, posteroventral lobe weak; epimeron 3 posterior margin lacking tooth, no concavity . . . *A. intermedius*

   Coxa 3, posteroventral lobe strong; epimeron 3 with large tooth, posterior margin with concavity 4

4. Peduncle of uropod 1 with 5–9 short, stubby spines; coxa 7 posterior margin subacute . . . . . *A. bousfieldi*

   Peduncle of uropod 1 lacking short stubby spines; coxa 7 posterior margin acute 5

5. Ventral margin of article 5 pereopod 6 with spines in 3–4 groups; uropod 1 inner ramus one-half outer ramus . . . . . *A. shoemakeri*

   Ventral margin of article 5 pereopod 6 with continuous row of spines; uropod 1 rami subequal 6

6. Peduncle or uropod 1 with 1–2 ventral spines usually present; 8-10 dorsolateral spines . . . . . *A. similis*

   Peduncle of uropod 1 without ventral spines; less than 8–10 dorsolateral spines 7

7. Peduncle of uropod 1 with a dorsally directed, posterodistal hooked spine; telson completely cleft to base, lobes giving the appearance of being separate . . . . . *A. uncinus*

   Peduncle of uropod 1 with single straight, posteriorly directed spines; telson cleft nearly to base . . . *A. millsi*

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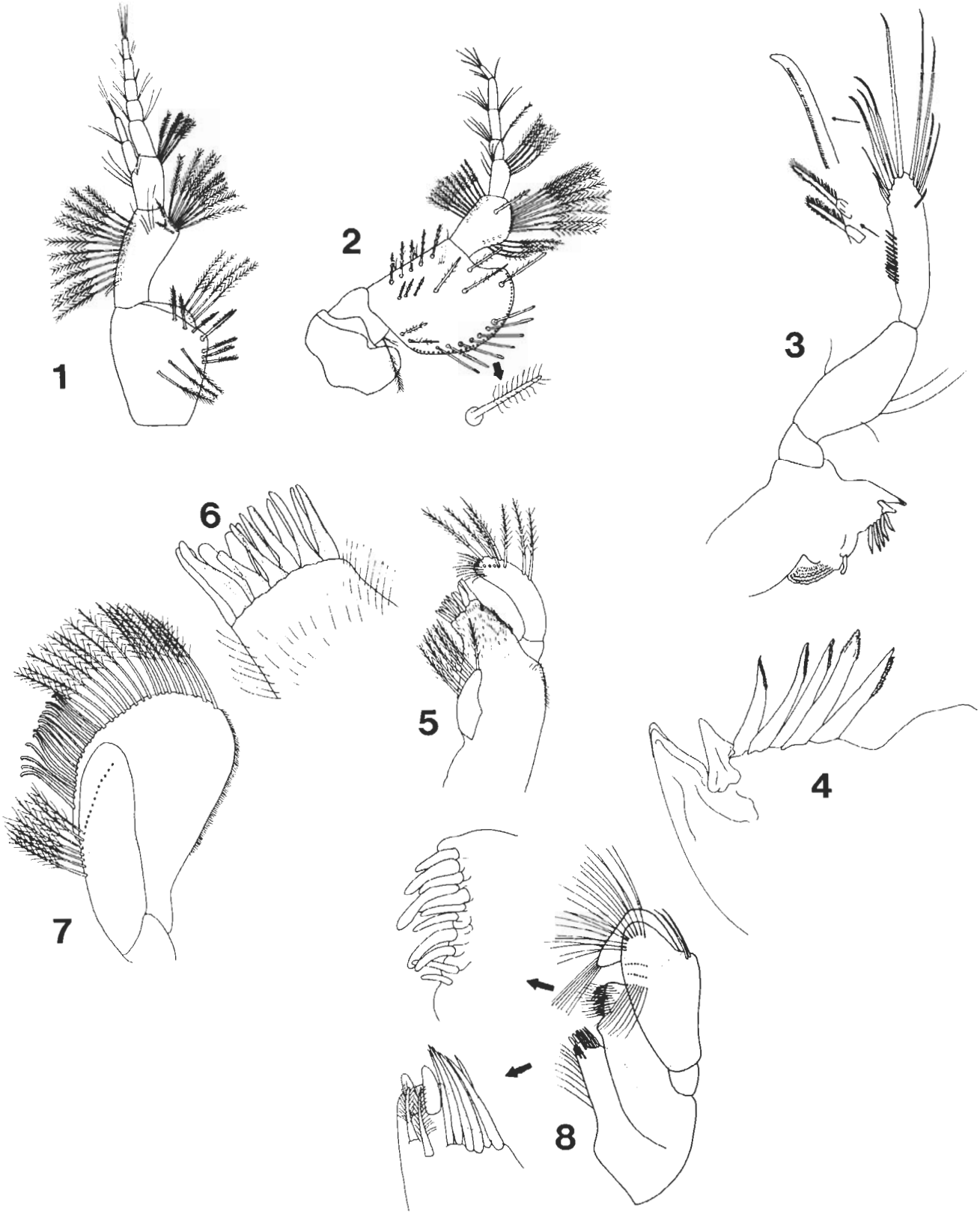


PLATE I

***Acanthohaustorius uncinus* n. sp. paratype female "a" 4.7 mm**

Figures 1–8. (1) Antenna 1; (2) Antenna 2; (3) Mandible with detail of palp segment 3 comb spines and terminal spines; (4) Mandible, detail of incisor, lacinia mobilis, and raker row; (5) Maxilla 1; (6) Maxilla 1, outer plate; (7) Maxilla 2; (8) Maxilliped, with detail of outer and inner plates.

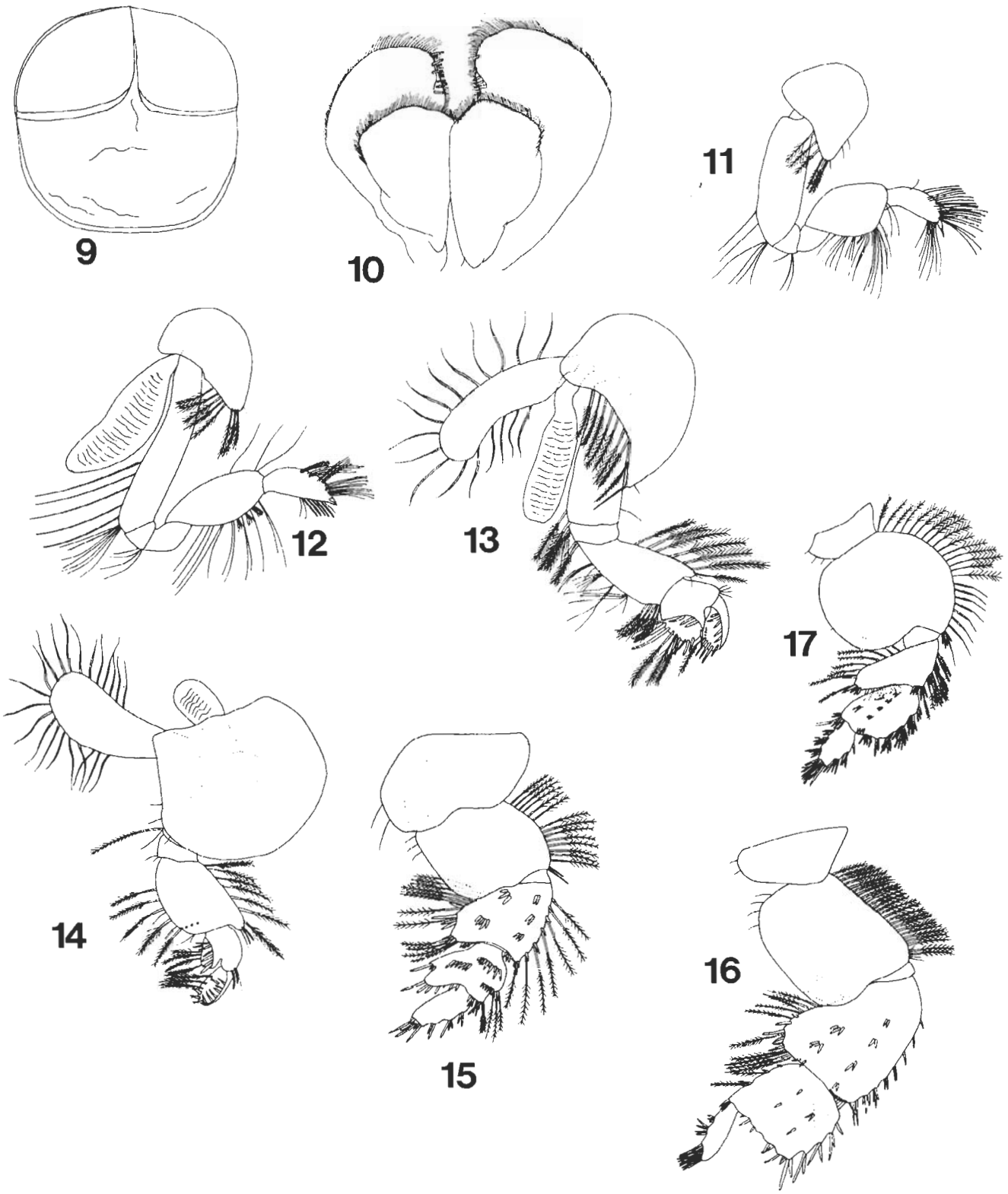
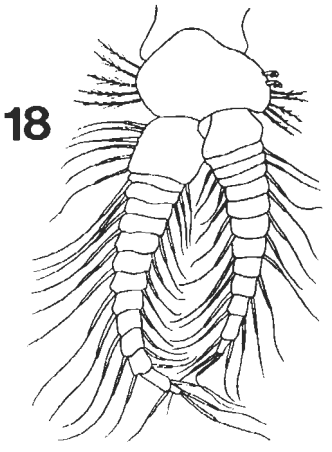
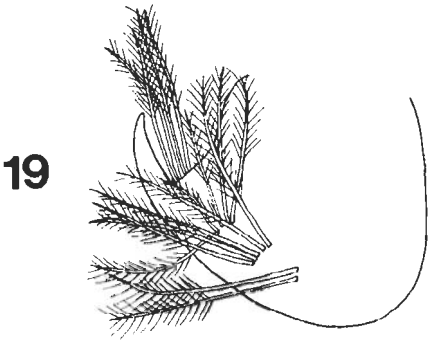


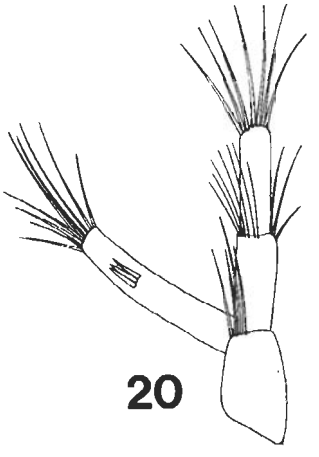
PLATE II

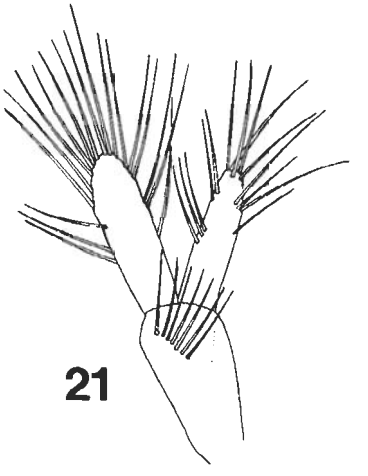
Acanthohaustorius uncinus n. sp. paratype female "a" 4.7 mm

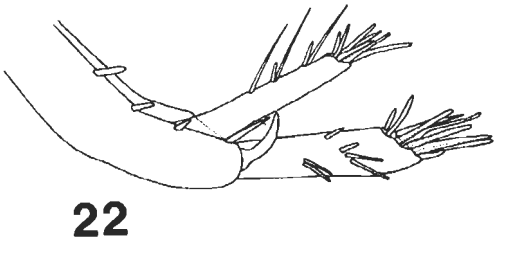
Figures 9–17. (9) Upper lip, (10) Lower lip, (11) Gnathopod 1, (12) Gnathopod 2, (13) Pereopod 3, (14) Pereopod 4, (15) Pereopod 5, (16) Pereopod 6, (17) Pereopod 7.











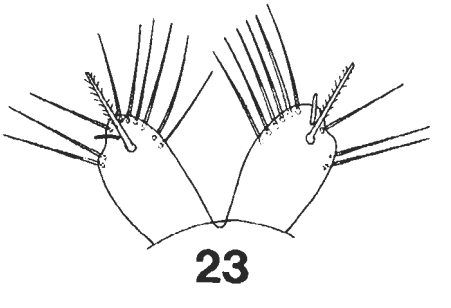


PLATE III

Acanthohaustorius uncinus **n. sp. paratype female "a" 4.7 mm**

Figures 18–23. (18) Pleopod 1; (19) Epimera 3, lateral view; (20) Uropod 3; (21) Uropod 2; (22) Uropod 1; (23) Telson.